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THE CALIBRATION OF THE LEAKAGE METER

By C. W. WOODWORTH

Some of the leakage meters put on the market prove to have been incorrectly calibrated and indicate excessive leakages. This has not been serious as long at the instruments have been used only for the comparison of samples of tent materials, but they should be corrected to suit them, for use in connection with dosage tables. This is easily done by using a reamer on the small opening from the brass tube to to the small chamber behind the cloth under the clamp. It requires very skillful work, however, and it is wise to return to the manufacturer for adjustment any meters that do not register correctly.

The present publication is intended to enable users of these instruments to determine approximately the correctness of this adjustment. The theory of the meter is that if two test plates were used to correspond with the two thicknesses of cloth to be tested then the diameters of the test plates would bear such a relation to the diameter of the sharp edge of the clamp that the areas of the smaller circle in the test plate should be between .20 and .25 per cent of the area of the larger circle of the clamp and precisely the amount shown by the test line on the meter. Instead, however, of using two test plates a single plate with a smaller hole of exactly the right size to make the same reading on the meter is furnished with the instrument. The smaller hole is just 84 per cent of the diameter that would give the right calculation of percentages of leakage through the doubled cloth, therefore for making calculations the diameters of the test plates must be increased.

The testing of the meter consists in measuring the size of the ring of the clamp and of the hole in a test plate and finding whether or not the actual test corresponds with the percentages calculated from the measurements of these sizes. Accurate testing requires very careful work but it is very easy to make a test sufficiently accurate to determine whether the instrument shows gross errors.

MEASURING THE CLAMP

The best way to measure the clamp is to use a piece of cardboard with which to take an impression of the ring, putting in several thicknesses, if necessary, to obtain a clear, sharp mark. After obtain-

ing the impression measure this carefully with a finely divided rule determining the nearest 64th of an inch. The size will be found to be approximately 5/8 or 40/64ths of an inch and the table below gives readings for possible variations for a sixteenth of an inch in either direction. A 64th of an inch variation modifies the reading by less than .02 of a per cent.

MEASURING THE TEST PLATE

The hole in the test plate is very much more difficult to measure accurately. The standard wire gauge known as the "Brown and Sharpe" gauge is to be had in every machine shop and is perhaps the most accurate measure for this purpose. Lay this on the test plate and examine it under a pocket lens. The hole should appear as shown in figure 1. Another method is to make a test plate by the use of an

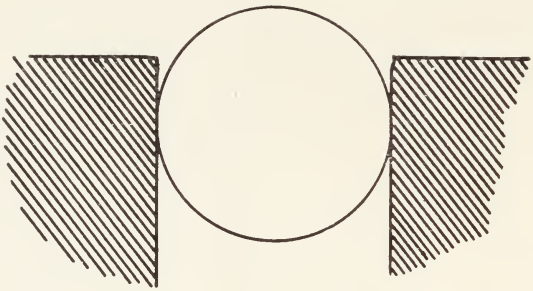


Fig. 1.—The way the hole in the test plate should appear under the wire gauze as seen through the microscope.

ordinary sewing needle. This method will probably prove more accurate with most people than the use of a wire gauge because of the practical difficulty of making the comparisons under the microscope. The best test plates made in this manner are with soft metal, like copper, lead or zinc. A very thin sheet of these metals can be very easily perforated. Fair results can be secured by using a piece of good quality writing paper or cardboard. The fiber in the softer cardboard swells out and partially closes the hole and so gives low readings. If it is found that a needle fits tightly in a hole after withdrawing it a few minutes it is not suitable.

A very good method is found to consist in perforating a sheet of celluloid in rather hot water, then placing the celluloid in cold water and leaving the needle in position until the celluloid is cool. The hole under these circumstances proved almost if not quite as good as in metal.

In all cases thrust the needle through to the middle so as to have the full width of the shaft.

The use of the needle is so simple and convenient that it will probably be the most satisfactory method in practice to make a new test plate rather than to attempt to measure the one furnished with the instrument.

MAKING THE TEST

The test plate is clamped in the instrument and the reading carefully made in the same manner as in testing tent material.

Comparing this with the calculation given in the table in the column under the diameter of the hole in the test plate and the line of the diameter of the clamp ring enables one to determine the per cent of error. When the table values differ from the determined value the error is approximately 6 per cent for each line. The difference of adjacent columns is approximately four times as great.

One degree on the meter between .15 and .20 corresponds with about six lines, between .20 and .25 four lines and from .25 to .35 about three lines. If the observed error is greater than this, the instrument should be sent to the maker for adjustment, and perhaps even for a lesser error, rather that to try to adjust by reading "strong" or "weak."

TABLE FOR TESTING LEAKAGE METERS

Wire gauge No.	20	21	22	23	24	25
Needle No.	5	6	7	8	9	10
Diameter	.032	.028	.025	.022	.020	.018
Augmented	.038	.033	.030	.026	.024	.021

Diameter of clamp			*Correct meter readings × 100*					
36–64ths	.564 in.	14.3 mm.		35	28	21.7	17.9	14.5
37	.580	14.7		33	26.4	20.4	16.9	13.6
38	.595	15.1		31.5	25.0	19.5	16.0	13.0
39	.610	15.5	39.0	29.8	23.8	18.5	15.3	12.4
40	.625	15.9	37.0	28.5	22.7	17.6	14.6	11.7
41	.642	16.3	35.0	26.9	21.5	16.7	13.8	11.2
42	.658	16.7	33.3	25.6	20.5	15.9	13.1	10.6
43	.672	17.1	32.0	24.5	19.6	15.2	12.6	10.1
44	.688	17.5	32.5	23.5	18.7	14.5	12.0	

CALCULATION OF THE TABLE

While it is not necessary to make any calculations to test a meter it will be well to explain the calculation of the above table.

The easiest method of doing this is by the use of a slide rule, the settings of which are as follows:

$$\frac{C}{D}\frac{21}{25} = \frac{C}{D}\frac{\text{needle diameter}}{x} \qquad \frac{C}{D}\frac{\text{clamp diameter}}{x} = \frac{A}{B}\frac{y}{1}$$

x = augmented needle diameter to allow for doubled tents.
y = correct meter readings of per cent of leakage.

SUMMARY

Some leakage meters are so inaccurate that they are unsuitable for use as guides to dosage.

The accuracy can be easily tested by measuring the clamp ring and the hole of the test plate.

Needles can be used to make test plates making their measurement unnecessary. The amount of the inaccuracy is determined by comparing the reading with a table. If found inaccurate the instrument should be returned to the maker for adjustment.